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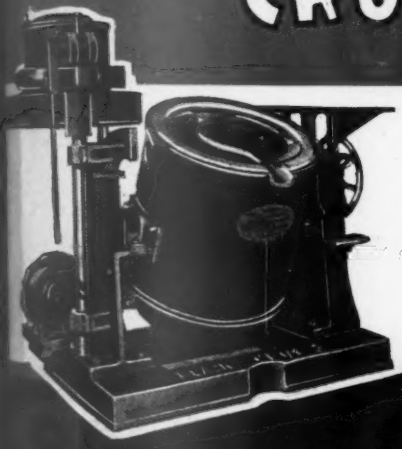

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FOUNDRY TRADE JOURNAL
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Vol. 69 Thursday, April 15, 1943 No. 1391

Towards a Scientific Basis

Many years ago we were called in to report upon the cause of excessive scrap in the making of some printing machine castings. Deciding to investigate the melting conditions first, we gave initial consideration to the current cupola practice. As a leading question we asked of what the charge consisted. The ratio of pig-iron apparently *depended* on the scrap available and what was to be made. The coke ratio also *depended* on the scrap and the state of repair of the lining. Thus, the story continued, every factor *depended* on some other quite uncontrolled factor. We recommended the purchase of a weighing machine and the adherence to some simple standardisation of mixtures and coke ratio. Apparently this elementary piece of advice was successful, for no further action was required. Since that time, with negligible exceptions, cupola practice has been conducted throughout the country on a rational, well-controlled basis. Yet when mould making and the running of castings is considered the position is much the same as was cupola practice a few decades ago. Some firms have standardised quite a number of factors, but with others the word "depends" is still too prevalent. On a mass-production job we examined only last week, control extended to the composition and physical properties of both the mould and core sand; the density of ramming; the gating system; the teeming speed; and, of course, the metal, both as to temperature and analysis. E. Longden has recently reviewed the fundamental principles indicating the use of hydrostatics in foundry practice and he clearly shows that this can be put on a scientific basis, and the weighting and reinforcement need not *depend* on anything other than strict mathematical laws. The rules governing the subject of gating, running and risering of castings, with the dual object of excluding entrained slag and ensuring soundness in all parts, still require precise enunciation. In recent times Currie and Harding, and Rominski and Taylor, have published data which indicate that basic principles exist; that in all probability they are susceptible to mathematical expression and thereby creating the possibility of practical application to any normal design of casting. In cases where it is impossible to apply the concepts so derived then it can reasonably be assumed that the design must be changed if the component is to be made as a casting. For years, foundrymen have been arguing as to the best method of gating certain types of casting, and invariably a sort of gentlemen's agreement is reached based on the notion that "there are more ways of killing a cat, etc." Yet it is but logic to state that there must be one best method, though the question is often complicated by the choice of moulding in respect as to whether the top, bottom or side should be cast uppermost. Tests carried out on the lines utilised by the Sheffield Branch of the Institute of British Foundrymen recently should provide a solution. The study of isothermal lines is a prerequisite to the elimination of porous patches. Perhaps we are too idealistic in our outlook, but we are convinced that sooner or later most of the innumerable variables in foundry practice will be very largely ironed out and even the jobbing foundry will be able to conduct its business with a much higher factor of safety than has been the case since the days of Tubal Kain.

Analyses of defective castings, which have been available in recent times, clearly show that but a small percentage are ascribable to the metal and that the majority are due to inadequate gating systems. There is some need for a new way of expression which would catalogue scrap castings under but two headings—due to the human element and to inadequate knowledge. By correlating the mechanical with the psychological analyses, the valuable results obtained should enable the foundrymen of the future to ascribe every scrap casting to failure of human element.

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PATTERNMAKING WRINKLES—X

By "CHIP"

One of the problems often presented to the patternmaker is how to construct the pattern to conform to the drawing and still retain the necessary rigidity for moulding purposes. This problem is principally associated with such types of castings as sole or bedplates, in which the general metal thickness is light, but generous curves are designed to give a pleasing appearance to the finished machine. Fig. 1 illustrates such a case, where the metal thickness is ½ in. and a curve of 4 in. radius is specified. The writer has known cases where the requirements of the designer have been ignored and the corner made as Fig. 2, in which two pieces A and B are screwed together and reinforced by a small fillet C, while the corner is only slightly rounded; this construction being adopted for strength in the pattern. An improvement on this

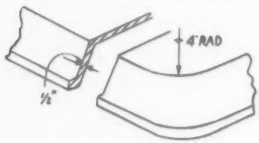

FIG 1

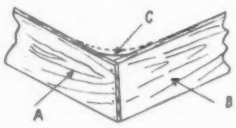

FIG 2

FIG 3

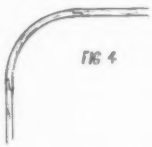
FIG 4

would be by making the pattern similar, but for a large fillet shown dotted in Fig. 2 and an extra piece as Fig. 3. This is used to stop off the portion of the mould not required, and thus make an equal metal thickness throughout. Another method would be to make the curved corner with the grain running vertical and joining up as Fig. 4. The objection to this method is the weakness of the corner. An alternative which retains the advantage of Fig. 4 without the disadvantage is to build the corner as a segmental construction and join into the straight sides.

Work Stools and Work Stand.—A leaflet received from Steel Products (Bingley), Limited, Clyde Mills, Bingley, Yorks, describes and illustrates, among other items, a thoroughly practical works stool. They are made in three heights, carrying sponge rubber seatings, with loose cloth covers and normally a padded back rest. A second item is a multiple work stand, resembling without frills the articles of furniture used for afternoon teas, and carries four 18-in. dished trays. It would in many cases form a useful adjunct at the side of a moulding machine.

CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

FERRO-ALLOYS IN AUSTRALIA

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In the interesting Paper entitled "Ferro-Alloys in Australia," by Mr. W. Hewitt and published in the JOURNAL for February 11, there are a few points which call for criticism, more particularly in the section devoted to the use of ferro-alloys in cupola practice.

In this part of his Paper the author quite rightly emphasises the high oxidation losses which are obtained by the addition of lumpy ferro-alloys to cupola charges, and recommends the use of briquetted alloys, which is a practice largely adopted in foundries on the Continent, in America and to some extent in the U.K. His statement, however, that ferro-alloy briquettes are made by pouring molten pig-iron round weighed lumps of ferro-alloy is apt to be misleading, as the term connotes something quite different in other countries. Briquettes used in European and American foundries consist of crushed alloys from which dust is eliminated before mixing with a binder and briquetting in moulds under pressure. These briquettes contain definite quantities of the alloying element, and oxidation losses are negligible in the case of silicon briquettes and small in the cases of manganese and chromium.

Another point which is at variance with all practical experience elsewhere is the statement that ferro-silicon causes grey iron to have very large graphite flakes. One of the main advantages, stated years ago, for using silicon briquettes was its value in the production of high-tensile cast iron (as known in those days) from charges containing a medium-silicon pig-iron and scrap, in which the required silicon content was obtained by the addition of briquetted ferro-silicon.—Yours, etc.,

J. H. WILLIAMS,
Metallurgist,
F. & M. SUPPLIES, LIMITED.

London, E.14.

A New Ceramic Coating?—The problem of rust and corrosion resistance for war products of ferrous metals has led to the creation of a new type of rust and corrosion-resistant ceramic coating, states E. HOGENSEN, of the Chicago Vitreous Enamel Product Company, Cicero, Ill., in "Steel." It is based on an entirely new process, being neither a porcelain or vitreous enamel nor a paint or lacquer or synthetic; it is designed to meet the war requirements in connection with colour and low reflectance value. This new ceramic coating, Armour-Vit, is baked or cured at 370 to 430 deg. C. about one-half the temperature normally employed for most of the vitreous-type ceramic coatings. It should make possible the conversion of many products to steel, from brass, copper and other critical metals.

ACID RESISTANCE AND TECHNICAL CONTROL IN AN ENAMELLING PLANT

Laboratory testing of enamels and some examples of steel enamelled equipment (Continued from p. 283)

By W. MONTGOMERY

Testing Enamels with the Mobilometer

An enamel slip is a plastic material and is very similar in this respect to a paint. For determining the consistency it will be seen from the foregoing that ordinary viscometers are not suitable for such tests. The simplest and easiest to operate of the instruments for measuring the consistency of plastic materials is the mobilometer. This instrument is particularly suitable for testing enamels, and is shown in the foreground of Fig. 9.

The best procedure is to first obtain a thorough mixture of the slip to be tested, and this can most readily be accomplished by mechanical agitation of the slip in a closed container for a period of 10 min. This period of agitation has a profound effect on the results obtained and must be standardised to get consistent results. The amount of water in the slip likewise has a decided effect on the results obtained, and it is best to control this factor within a narrow range, dependent on the type and working properties of the set-up concerned. After the water content is adjusted and the slip agitated, it can be added to the cylinder of the instrument and the determination proceeded with.

The rate of flow of the plunger falling through this known volume of slip is plotted against the shearing stress causing the flow, and the slope of the curve obtained is a measure of the mobility. The point where the extended curve intercepts the weight axis is taken as the yield value. The time which elapses between successive falls of the stem assembly will usually be found to affect the results, and the writer would advise that the stem and disc be not wiped, but only allowed to drain free of surplus enamel before being immersed for further runs. The thixotropy of the slip is possibly the governing factor in this case. It is very true that the "set" of an enamel drops off very rapidly with increase in temperature. Practical enamellers will agree that on a very hot day in summer the slip will lose "set" and be more difficult to apply. It is unnecessary, of course, to remark on the pronounced effect which variations in the amounts of electrolytes present in the slip have on the mobility. The above factors can readily be tested and investigated by means of the mobilometer. Moreover, the instrument has proved extremely useful in this particular plant for investigational as well as for control work.

Some useful instruments which are used in the production line and which are indispensable for the maintenance of a Grade 1 throughput are shown in Fig. 9. The magnetic thickness gauge can be of definite advantage. The test does not end with the measurement of depth of enamel layer, but rather with the modifications to technique which the results will surely suggest.

In vessels which have subsequently to withstand chemical attack, small blemishes on the enamel which might tend to expose metal may be disastrous. Indeed, it is advisable to search out such flaws diligently and, at the inspector's discretion, either to repair them or reprocess the entire vessel. For this purpose, both the high-frequency electric spark tester and a low voltage Megger type of tester are used.

The former instrument is used on all vessels processed by the dry or "hot-dust" method. By this

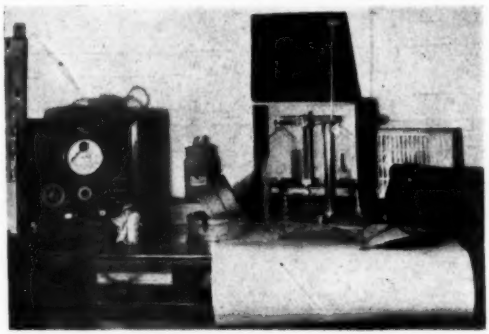

FIG. 9.—TESTING APPARATUS USED ON THE PRODUCTION LINE.

means, the mains voltage is stepped up and the actual potential behind the discharge is in the region of 10,000 volts. The unbroken enamel surface is, naturally, a non-conductor, but so soon as the wire coil at the discharge end of the machine is proximate to a flaw, the high electric pressure results in a spark bridging the gap to the metal surface, and so to earth. This instrument is inexpensive and cuts the testing time down to a minimum. The nature of this test precludes the possibility of any serious flaw being overlooked. At one time, the suspicion existed that maybe the application of such high voltages to the enamel layer might fracture even a coating of perfect insulating power. Any years that existed were dispelled by applying the discharge over a single spot on

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the glass surface for an extended period. In fact, after two transformers had been "burned out," the enamel still withstood any induced stresses.

Voltmeter and Milliammeter

This instrument, shown on the left-hand side of Fig. 9, is used on vessels which have been enamelled by the wet or spray method. In principle it is similar to the Megger tester. The surface under test is swabbed with the pad, which is saturated with a 1 per cent. solution, of phenol phthalein. Any pinholes or areas of excessive thinness which give contact and thus complete the electric circuit produce a pink coloration on the pad. Full-scale deflection is obtained on the galvanometer panel, and so soon as contact is made the pointer indicates the presence of a flaw.

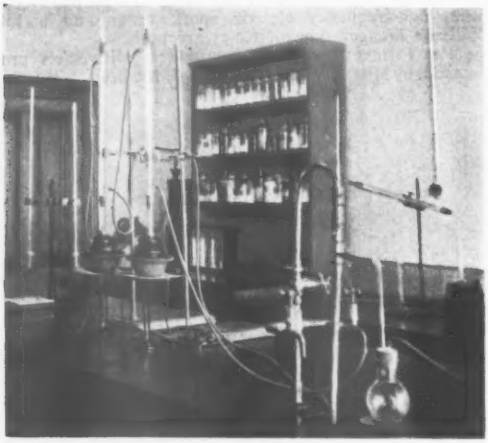

FIG. 10.—LABORATORY ACID-RESISTANCE TEST.

The reason for using a low voltage test on sprayed articles is that the presence of clay and electrolytes in the slip renders the fired surface quite permeable to a high voltage discharge.

Laboratory Tests

There are, unfortunately, no standard and strictly comparable methods for testing the more empirical properties of vitreous enamels. Shatter or impact values, acid resistance and resistance to thermal shock—to mention only three—are often matters of pure conjecture, and the values given vary, from plant to plant, with the individual methods of testing used. It is to be hoped that, when industrial life returns to normal, enamellers will make closer co-operation in this matter a part of their post-war plans.

An attempt was made some time ago to evolve a standardised procedure for the testing of acid resistance. This recommended method was issued by the Joint Committee on Vitreous Enamelling of the I.V.E. and B.C.I.R.A., and the details of the method are given in their publication. The most resistant enamel which they figure gave a result of 12 mg. per sq. dm. loss, while a steel enamel of the writer's gave as the loss in weight of 0.5 mg. per sq. dm. A (cast-iron) glass, regularly used in production, gave a loss in weight of 0.7 mg. per sq. dm. when tested with oxalic acid, according to the standard procedure.

It would seem that a shortcoming of this test is that it does not take into account the existence of super-resistant glasses. The point is, that degree of attack is quite considerable in the usual types of

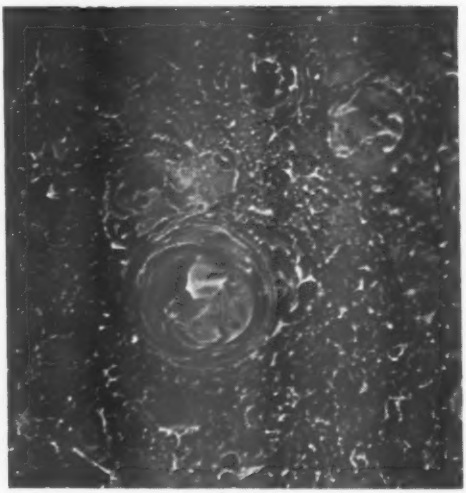

FIG. 11.—ENAMEL SURFACE ETCHED WITH HYDROFLUORIC ACID IN ALCOHOL. (× 500.)

enamels, but that in highly resistant glasses the losses are only fractions of a milligram and, in such cases, results are difficult to duplicate. When weighing to such small fractions the personal factor largely influences results and, for comparisons, the difference of one milligram might alter the relative positions in a list of enamels arranged in order of their resistance to attack.

In personal practice a reflux resistivity test is carried out, in which an adaption of the usual Soxhlet extraction apparatus is used. Hydrochloric acid of 20.8 per cent. by weight strength is used, and the test can be conveniently carried out in either the vapour phase or the liquid phase at a standard temperature and time. The powdered fraction which is taken for test is always carefully graded first, and, for the vapour

phase test, is suspended in a little container made of platinum gauze. This method ensures that a much greater area of contact is obtained.

The test cup method finds ready application when the behaviour, on these enamels, of an untried chemical needs some investigation. Two enamelled test cups are clamped together, with a suitable gasket between the flanges, as shown on the photograph in Fig. 10. The upper cup has a conveniently shaped hole bored through it in order to make a good connection with the cork of a reflux condenser. Thus, measured amount of the particular "devil's brew" under test may be refluxed within the cup for periods extending, if necessary, into weeks. Quantitative results may be obtained from the measured loss in weight, but, generally speaking, it is sufficient to note the nature and degree of surface attack by means of a suitable magnifying glass.

The method used for testing the adherence of the

FIG. 12.—BODY OF ENAMELLED REACTION VESSEL.

enamel to the metallic base is, it must be confessed, somewhat empirical. It consists of a frame arrangement, so constructed as to allow a 100 gramme steel ball to fall through a distance of 50 cm. on to the surface being tested. The number of consecutive blows necessary to cause primary flaking is reported as the "impact value." Using the thickness meter as an aid to deducing results, this impact figure is useful in estimating the ability of an enamel to resist shattering.

Fusion Points

The procedure used in these laboratories for determining the fusion points of glasses is that of plotting cooling curves. To do this a platinum-rhodium thermocouple is placed in molten enamel, contained in a crucible, and the temperature plotted against the rate of cooling. The heat of fusion causes a break in the cooling curve from which data can be obtained for determining the fusion temperature. Fusion, of course, usually takes place over a range of temperature, depending on the melting points of the compounds forming the batch. Never does one obtain a perfectly homogeneous melt. Apart from the minute particles of undissolved refractory which may be present more than one phase usually separates from

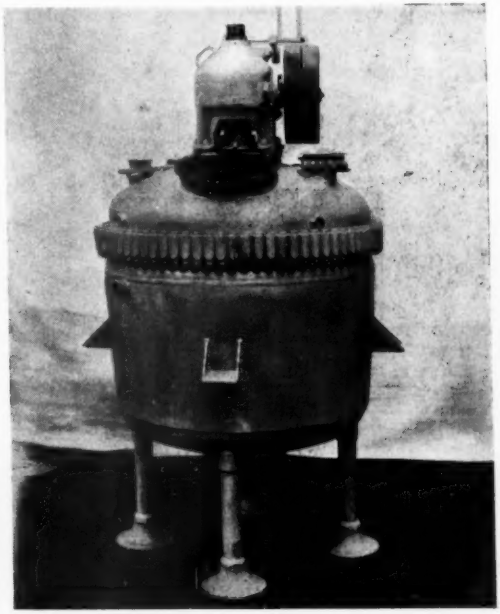

FIG. 13.—ASSEMBLED ENAMELLED REACTION VESSEL.

the melt as solidification proceeds. An area of the solid enamel less rich in silica than its surroundings would be preferentially dissolved by acids, and it can be accepted that the lower melting point phases will tend to rise to the surface.

The microscope is a valuable aid to such studies and the micrograph (Fig. 11) illustrates the above points. The photograph was taken at a magnification of 100 diameters and the surface of the well smelted and fired enamel was etched with a 10 per cent. solution of hydrofluoric acid in alcohol. The acid attack is seen to be preferential, and not uniform, in character and thus gives a "grain" effect. The manner in which the molten enamel heals over gas cavities before solidification is also well shown. Although silicate glasses are, in general, amorphous

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solid solutions, these facts should be borne in mind when considering resistance to attack by chemicals. *No silicate enamel will resist solution by alkaline liquids and more particularly hot caustic alkalis.*

Certain chemical engineering applications have rendered the ability to resist fatigue under conditions of rapid temperature changes an important property of these enamels. The test is made in the laboratory by heating enamelled specimens to a predetermined high temperature and quenching them in water. This cycle

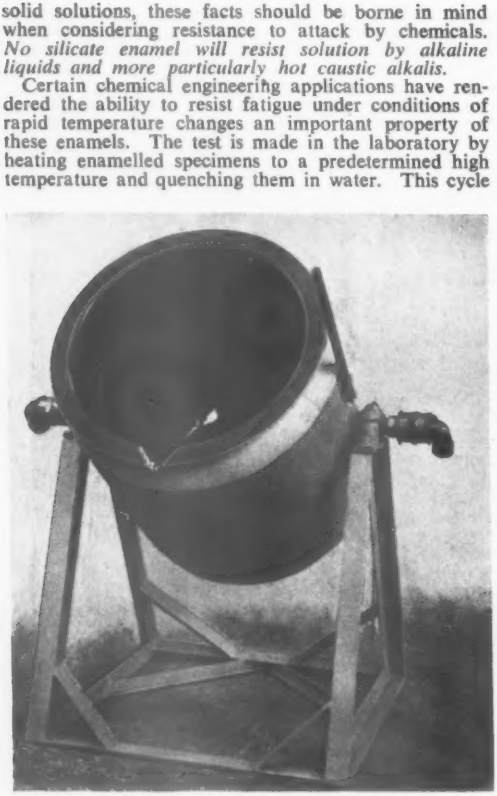

FIG. 14.—POURING VESSEL FOR CHEMICALS.

of operations is repeated until there is indication of failure, and the number of successive changes in temperature is regarded as the index of quality. Titanium oxide in an enamel improves this property considerably. In fact, the inclusion of titanium oxide in the ingredients of enamel formulæ represents one of the material advancements of recent years in the manufacture of frits. In addition, this oxide favourably affects the fusibility and the acid resistance of enamels.

Other Standard Tests

It is not intended, in this Paper, to review the many standard tests which have been developed by glass technologists, and since applied to ceramic materials. Cubical expansion, thermal conductivity, opacity, gloss, tensile strength and specific heat are all properties of importance, but are well described elsewhere. Fundamental research was early carried out on glass, but the work has since been closely paralleled on vitreous enamels.

The early workers published many worthy contributions of great interest to the searcher after greater chemical resistance in silicate coatings. In personal opinion, the aim should be towards simpler formulæ. The simpler boro-silicates, titanates, zirconates, etc., offer better acid resistance and superior working properties. The chemical composition of these formulæ is much better balanced, with regard to acid and basic radicals, than that of the older and more complex mixtures. The immediate result is the attainment of

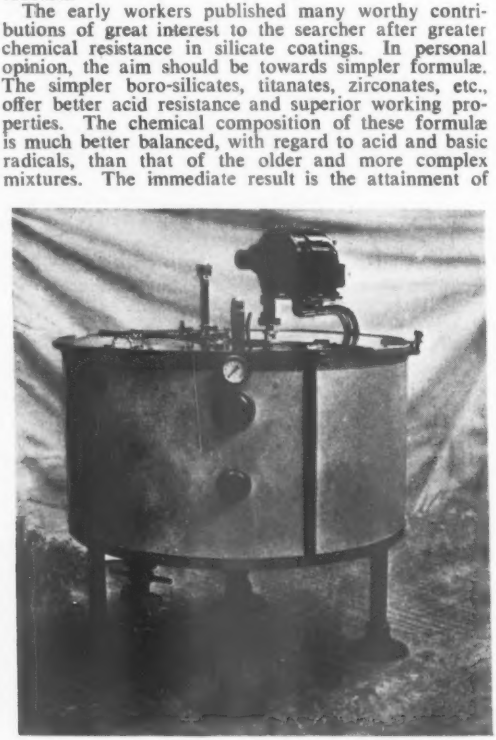

FIG. 15.—TYPICAL SMALL FINISHED VESSEL WITH FITTINGS.

a more neutral glass with, obviously, more resistant properties. The acid radical part of the composition has a profound effect on both the fusion range of a glass and its acid resistance.

EXAMPLES OF STEEL ENAMELLED EQUIPMENT

The photographs of enamelled chemical equipment shown in Figs. 12 to 15 will interest enamellers and, at the same time, give the engineers food for thought. The line of completed milk storage vessels, shown in Fig. 16 as awaiting shipment, is somewhat reminiscent of things past, but holds, for the enamelling industry, the promise of happier days to come.

The agitator or stirrer shown in Fig. 17, whether it be made in cast iron or steel, constitutes a tricky enamelling proposition. The design needs careful consideration, as the blade tips, acting in a manner similar to radiator fins, pick up and lose heat at a faster rate than does the stock.

In order to obtain otherwise unobtainable data on the behaviour of the enamel layer when subjected to excessive stresses in practice, a full-scale plant test was conducted as follows:—Ever-increasing steam pressure was applied to the jacket of an enamelled reaction vessel and the behaviour of the glass under the stresses imposed by the steadily expanding base metal was closely observed. The shell was tested to destruction and the interesting point lies in the fact that the enamel layer did not begin its initial flaking (at the radii) until 85 per cent. of the total pressure had been applied. Although considerable yield must have taken place in the steel at lower pressures, it does seem astonishing that no flaking took place in the lining till a jacket pressure of 475 lbs. per sq. in. had been reached. The enamel fracture shown on the right of Fig. 18 is worthy of study, as the adhering glass takes a pattern peculiar to such compressional failures.

(To be continued.)

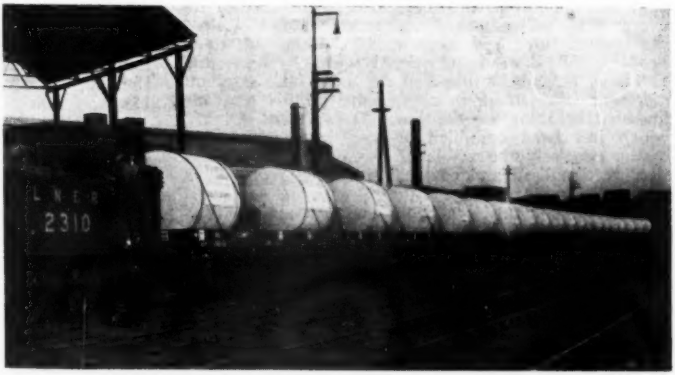

FIG. 16.—GLASS-LINED VESSELS READY FOR DESPATCH.

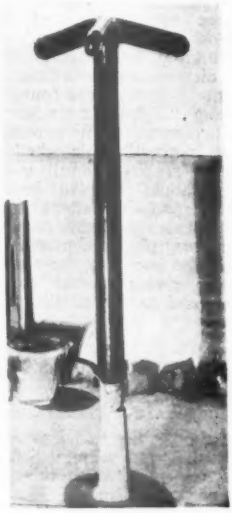

FIG. 17.—ENAMELLED STIRRER.

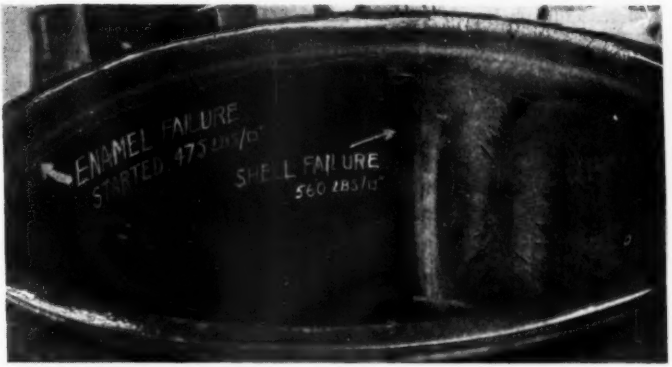

FIG. 18.—SHOWING THE RESULTS OF A FULL-SCALE PRESSURE TEST.

A 1,000,000-volt industrial X-ray unit has been installed at the University of Rochester as a joint contribution to war production of eight local industries and the university. Described as one of the most powerful units in the world, the machine will be capable of penetrating heavy steel castings for detecting various types of flaws.

To train power and fuel-economy engineers, the Haus der Technik, Essen, in co-operation with the Zentrale für Gas und Wasserverwendung, Berlin, and the Gaswärme-Institut, Essen, has organised first and supplementary courses of instruction in the use of industrial gas. Each course consists of a series of lectures spread over four days.

BOOK REVIEWS

Commodity Control. By J. B. Freeman and N. H. Hignett. London: Butterworth & Company (Publishers), Limited, Bell Yard, Temple Bar, W.C.2. (Price 15s., postage 9d.)

This volume, which covers the emergency legislation imposing control of the manufacture or supply of commodities other than food, is a reference book of up-to-date information on a subject made very complex by the spread of Government control to every phase of industrial and economic life. Both the manufacturer and trader are faced with the daily problem of ascertaining exactly what duties and liabilities have been imposed on them, and constant alertness is essential to escape the pitfalls and the innocent breaking of the law. The present volume, which has been compiled by two legal authorities, covers concisely the whole of this emergency legislation, sectionalised and carefully indexed to provide a reliable working guide.

A list of contents is a better guide to readers than a critical review in the present case. Tables of Statutes, statutory orders, and cases, are followed by an introduction setting forth the object and arrangement of the work, then 13 chapters and eight appendices. The chapters deal with the creating and functions of wartime Ministries; the Emergency Powers (Defence) Acts, 1939 and 1940; control applied by Part IV of the Defence (General) Regulations, 1939; miscellaneous administrative provisions; control of employment; imports and exports; concentration of production; limitation of supplies and control of manufacture and supply; price control, the Goods and Services (Price Control) Acts, 1939 and 1941; provisions directly applicable to retail trading; control applied to special industries; effect of control upon pre-existing contracts; offences, penalties and proceedings. Every wartime Statute or Order, up to February last, which comes under the above heads is given in full, with copious footnotes and references.

The appendices give a complete schedule of orders and regulations imposing, applying, relaxing or removing controls arranged alphabetically according to the commodity or group of commodities affected; local price regulation committees; local addresses of licensing officers of the Ministry of Works; control of building operations; concentration of production (explanatory memorandum); the Goods and Services (Price Control) Acts, 1939 and 1941; the Defence (Recovery of Fines) Regulations, 1942; and the schedule of names and addresses of official departments and Government officers by whom commodity control is applied. Orders relating to materials of interest to foundries and iron and steel works are listed in Appendix I under building and civil engineering; chemicals; fuel and lighting; fuel control generally; heating apparatus; hollow-ware (domestic); machinery plant and tools; metals; minerals (other than coal); salvage; and storage. The work closes with an alphabetical index of 32 pages.

As with the appearance of new orders and regulations, this compendium automatically falls out of date, the publishers will issue supplementary matter as cumulative pocket supplements to fit the pocket provided at the back of the book, to keep the record in step with the times. This is a useful feature of the work and is highly commended. On the whole, the volume will be found of the greatest value to all seeking complete information on the maze of regulations affecting commodity control. It is well produced and very reasonably priced, in sharp contrast to many current technical works.

E. R. F.

Modern Industrial Lighting, by G. Bernard Hughes. Published by Hutchinson & Company (Publishers), Limited, 34, Paternoster Row, London, E.C.4. Price 15s.

This is the first "authorised economy standard" book the reviewer has so far encountered, and beyond finding the length of the lines a little trying for the eyes—even in daylight—its presentation is in every way satisfactory. The foundry industry was amongst the first to take lighting seriously, and the publicity matter of the illuminating engineering authorities bristles with examples of outstanding accomplishment. In this book the frontispiece and the last of the grouped half-tone illustrations both show foundries. One point is brought out forcibly, and that is that reflectors soiled by foundry dirt reduce the efficiency of the lighting by 75 per cent. Now that the foundry has established itself as being "lighting conscious," it should enhance its good reputation by constant attention to maintenance. It is questionable whether the average foundry executive requires a full scale text book on the subject, but should the plant be of such a magnitude as to warrant specialised attention to lighting, then the reviewer can unreservedly recommend this work, as it covers every phase of planning, installation and maintenance. The book runs to about 130 pages—a deceptive figure owing to the more complete utilisation of paper—and carries 65 illustrations.

V. C. F.

The Raw Materials Guide. Issued by the Ministry of Supply, and published by H.M. Stationery Office, York House, Kingsway, London, W.C.2. Price 1s. net.

If there be a fault with this book, it is that it is too interesting. Thus a foundry manager searching for the address of the "dextrine control" (which he will not find because it comes under the Ministry of Food), will find himself learning all about exotic gums, the extraordinary materials derived from molasses, and the difficulties in procuring the raw materials for pesticides, and consequently time will be wasted. It is like referring to Whitaker for the state of the National Debt in 1931, but finding interest in the Derby winner, the cricket championships, and so on. The book gives the best appreciation possible of the meaning of the prosecution of economic warfare, though, of course, it adequately fills its purpose as a guide to the acquiring of raw materials for manufacture.

V. C. F.

DIE-CASTING PROGRESS IN AMERICA IN 1942

SUCCESSFUL SUBSTITUTION OF SECONDARY ALUMINIUM—DIE STEELS WITHOUT VANADIUM—DIE-CASTING MACHINES

The American die-casting industry has been so concerned with production during the past year that there has been little time for new developments, writes BRUCE W. GONSER, of the Battelle Memorial Institute, in a progress report for 1942 in "Steel." Most changes have been in casting new war products and in using substitute or secondary materials rather than in process and equipment improvements. Civilian use of die-casting has practically ceased and all available capacity turned to war work. Consumption of zinc base alloys is consequently now less than that of aluminium die-castings. Ammunition components such as fuse bodies, windshields, booster cups and rotors use immense quantities of aluminium die-castings; also ordnance aircraft and naval equipment include many die-castings of aluminium. Zinc base alloys find application as diecast hand grenade bouchons, 20-mm. fuse bodies, closing plugs for projectiles, nose pieces for float flares, and the like.

At one time it was considered essential to use only primary aluminium for most of these die-castings. But in the past year, the substitution of secondary aluminium has been quite general in spite of the difficulties encountered. The skill shown in making this successful change speaks well for the industry. As an example, ammunition parts formerly made from high-purity 12 per cent. silicon aluminium are now produced from a more available secondary alloy having 4 per cent. copper, 9 per cent. silicon. Use of manganese base alloys and of brass die-castings has continued to increase, the former being used particularly in aircraft parts. A suitable die for casting copper base alloys is still a handicap to expansion in this field.

"Low-Grade Aluminium"

The use of low-grade metal, to save virgin aluminium, was also surveyed by D. L. COLWELL, Chief Non-ferrous Metals Substitution Section, War Production Board, Washington, who pointed out that due to the critical shortage of aluminium, it was necessary a year ago to reduce the aluminium content of zinc-base die-casting alloys from 4 to 2 per cent. increasing the zinc content accordingly. With the increased production of cartridge brass, the demand for high purity zinc for cartridge brass has been so great that this metal is even more critical than low-grade aluminium. The restriction on this use of aluminium, therefore, has been relaxed. Foundries are free to go back to their 4 per cent. composition.

"Low-grade aluminium" is defined as aluminium containing 4 per cent. of copper and 1 per cent. of either zinc or iron. This amount of copper adds about 0.16 per cent. to the zinc-base alloy. In the case of No. XXIII alloy, which is nominally copper-free, revisions in specifications have been made from 0.10 per cent. maximum to 0.25 per cent. maximum. This "low-grade aluminium" should be purchased with a rigid limit of 0.10 per cent. each on the lead and tin, as these materials are particularly harmful to zinc-base die-casting alloys.

In the field of aluminium die-casting, there has been considerable activity in military applications due to the ability of the die-casting process to use lower-grade material. Die-castings containing 4 per cent. copper, and between 5 and 9 per cent. silicon, have been widely used, serving as a substitute for virgin aluminium castings and screw machine stock. Die-casting has thus aided the conservation of aluminium. During 1943, it is expected that increased supplies of magnesium will make this material available as a substitute for aluminium in many casting applications.

A. D. WEIGOLT, of the Precision Castings Company, also dealing with the use of secondary and remelt aluminium, considers that the one thing which stands out most in the die-casting picture is the facility with which the industry has adapted itself to the change-over from the high-purity aluminium alloys formerly used by the government and which were thought indispensable for satisfactory results, to the secondary or lower grade remelt alloys. This change in material specifications enables a large reservoir of aluminium that is readily available to be tapped, but for which there otherwise would be only a very small or no market at all since non-military requirements have been denied aluminium of any kind. This should go a long way toward easing the aluminium shortage situation for the aircraft industry and in this way contribute substantially to the war effort.

Die Steels

Dealing with die steels for die-casting made without vanadium, R. P. KELLS, of the Latrobe Electric Steel Company, writes that the restricted use of critical alloys has not inconvenienced die-casters much, for steelmakers are continuing to produce satisfactory die steels for die-casting. The curtailed use of vanadium has caused no hardship because of the advantages gained by increasing the molybdenum content. Principal function of vanadium in die steels was to elevate the coarsening temperature of austenite, thus effecting stabilisation by preventing grain growth caused by accidental overheating in processing or heat-treatment. The necessity of close heat control was long ago recognised by a large part of the die-casting industry which provided itself with the necessary equipment and facilities for maintaining the temperatures required. Fortunately, molybdenum has the ability to raise the coarsening temperature, high-temperature strength and creep resistance.

To conserve strategic elements, steels of low alloy content may be used for casting the low melting point materials such as zinc, tin and lead. However, die-casting aluminium and magnesium, or their

Diecasting Progress in America

alloys, requires steels of high alloy content because of the high casting temperatures involved, a typical analysis of dies for such work is 0.35 per cent. C, 1.00 Si, 0.30 Mn, 1.25 W, 5.00 Cr, and 1.25 Mo. Special steels are required for casting copper base alloys because of the extremely high casting temperatures. The 8 to 15 per cent. tungsten hot-work die steels with carbon content ranging from 0.25 to 0.50 per cent. appear most satisfactory for this application. Regarding heat-treatment, every care should be taken that dies are heated slowly for hardening and are tempered thoroughly. The time consumed will be found to pay large dividends.

Die-Castings v. Forgings

Die-castings are now used on highly stressed aircraft parts where defects cannot be tolerated. By the intelligent use of the X-ray and fluoroscope, the die-casting industry is learning how to make sound and dependable die-castings, says CHARLES PACK, of the Doehler Die-Casting Company, New York. Development of a sound die-cast impeller for aircraft engine superchargers is an example. Tests conducted on such impellers show a minimum bursting speed of 50,000 r.p.m., and it is anticipated that such die-cast impellers will soon replace forgings. More and more die-castings are helping to eliminate bottlenecks in war production by replacing the limited supply of forgings and screw machine products.

Die-Casting Machines

F. W. MCINTYRE, of the Reed-Prentice Corporation, Worcester, Mass., reports that there has been a steadily increasing demand in the United States for high-pressure horizontal-plunger die-casting machines for producing aluminium die-castings, especially for the aircraft industry. Even with this industry's low production compared with pre-war motor-car output there is sufficient saving over other types of aluminium castings to warrant initial die costs. Securing a more dense, stronger casting has enabled them to reduce the size of the casting in many cases. A maker of small air-cooled gas engines required on portable equipment such as lighting units, power timber saws, fire pumps, etc., now finds he has sufficient quantities to warrant die-casting rather than the use of sand castings. There have been many substitutes made of high-pressure aluminium die-castings in place of steel and brass in ordnance work. Foreign countries purchasing equipment through Lend-Lease appear to have become more die-cast minded. They are purchasing machines, dies and trimming equipment. Future normal demand for equipment of this kind in foreign countries is indicated.

Developments in sight point to large machines and higher pressures for increased size of castings over those made in the past. These requirements have

(*Continued at foot of next column.*)

THERMAL STRESSES IN INGOT MOULD

In a Paper prepared for submission to the Iron and Steel Institute, on this subject, Mr. T. Land, of the Research Department, Messrs. William Jessop & Sons, Limited, Sheffield, has summarised his conclusions in the following terms:—

Cracking, caused by the thermal stresses set up during the casting of ingots, is a frequent cause of ingot-mould failure. A more exact knowledge of the effect of ingot-mould shape and the properties of the ingot-mould iron on the magnitude of the thermal stresses would be of immediate practical value. With this consideration in mind, the thermal stresses under certain conditions have been calculated. The Paper has been divided into two parts. In Section 1 of Part I, the stresses in a long circular mould have been calculated on the assumption that the physical properties of the ingot-mould iron are independent of temperature and of stress. It is shown that under these conditions the stresses at the outer surface would be roughly equal to the ultimate strength of the ingot-mould iron. The stresses in a very thin mould exceed those in one of normal thickness by about 20 per cent. In Section 2 the theory is developed to take account of the plastic deformation and varying physical constants of the cast iron, and in these circumstances the stresses are shown to be approximately half the ultimate strength of the mould material. Section 3 deals with moulds of non-circular section and Section 4 with end effects. In Section 5 it is pointed out that the surface stresses can be calculated from measurement of the temperature and expansion of the outer mould surface, and the exact relationships are set out. Arising out of this investigation suggestions are made for future experimental work. Part II of the Paper gives the detailed mathematical analysis discussed under Section 1 of Part I.

Cast Iron at Elevated Temperatures.—The U.S. War Production Board has approved a research project to study the possibility of utilising cast iron in operations at elevated temperatures (in excess of 450 deg. F.). The work is to be done by the War Metallurgy Committee, National Academy of Science, with the co-operation of the American Foundrymen's Association, and the co-operation of industry has been sought to locate specific applications in which cast iron is being or has been used, successfully or otherwise, at temperatures in excess of 450 deg. F.

(*Continued from previous column.*)

come from the aircraft industry. There is also a strong tendency to substitute plastic injection moulded parts to replace critical metals. This demand has taken up the production of a great percentage of the machines that were formerly used on products not essential to the war programme.

The above composite review of the die-casting industry in America has been compiled from contributions to " Steel."

MOULDING SANDS AND MATERIALS

SECOND REPORT OF THE MOULDING MATERIALS SUB-COMMITTEE OF THE STEEL CASTINGS RESEARCH COMMITTEE

Section IV.—Classification and properties of core compounds and sand mixtures, and notes on their uses

(*Continued from page* 266.)

SECTION IV—CORE COMPOUNDS AND CORE-SAND MIXTURES

In the foundry, sand mixtures containing clay as the essential binding material are usually termed moulding sands, whilst those containing organic binders are classed as core or oil sands. This nomenclature will be used below, even though some moulds are regularly made in organically bonded sands and cores are made in clay-bonded sands.

Core or organically bonded sand mixtures are used for a variety of reasons, each of more or less importance according to circumstances. Such mixtures are frequently more refractory than sands containing clay binders, so that little "burning-on" takes place. When the casting is poured, the organic binder is quickly burnt out, so that the core offers little resistance to the contracting steel. Both these properties contribute to ease of fettling. The dry strength of core sands is usually much higher than that of moulding sands, and the resistance to erosion by the casting stream is therefore greater when core sands are used. Many core sands contain a proportion of linseed oil or resin, and on standing after baking absorb water vapour less rapidly than the moulding sand after drying. Apart from the above, the use of core sands often offers local advantages in a particular foundry, depending on its equipment and layout. Most foundries buy their core compounds mixed ready for use, but a few prefer to buy the individual materials and add them in selected proportions to silica sand in a mill or a mixer.

Various materials used as core binders are briefly described below, and are grouped according to the basis of their utility. This classification is, however, not completely accurate, as some of the materials change on heating in more than one significant property, either simultaneously or successively. The substances most commonly used are nearly all imported into Britain, and many of them have a food value either in the form in which they are used in the foundry or after some kind of treatment. For both these reasons it is essential that these materials be used as economically as possible and that reductions in their consumption be secured wherever practicable. A number of alternative materials are mentioned, many of which are imported and are not available in sufficiently large quantities to be utilised generally. It may be, however, that substances similar in nature or in properties arise as by-products, particularly in some of the new wartime industries. In any such cases the members of the Sub-Committee would be glad to learn of them, to examine samples and to report on their suitability as constituents of core-binding materials.

CLASSIFICATION OF CORE COMPOUNDS

Class 1

These substances are solid, or nearly solid, at ordinary temperatures, soften or melt on heating, forming a film round each sand grain, and solidify on cooling, thus providing some green bond and a fairly good dry bond. The best-known example is probably common resin or colophony. Coal tar, pitch and creosote, or a mixture of these, are materials of domestic origin which are less efficient than resin, but have often been used in small percentages. Asphalt, or bitumen, behaves in the same way as resin, but is an imported material. Other resinous gums include copal, dammar, elemi, guiacum, mastic and sandarac, the commonest of these being gum copal. All of these are imported and are less plentiful than colophony.

Shellac is an imported resin which, apart from being soluble in alcohols, is soluble in some cheap inorganic alkaline solutions. The green and dry strengths of shellac solutions are, however, low. During recent years many types of synthetic resins have been developed, such as coumarone, glycerine, formaldehyde, alkyd and vinyl resins. These are soluble in various organic solvents, and the addition of a plasticiser gives solutions which develop both green and dry strength, which, however, is never very high.

Colophony, pitch, tar and creosote can be mixed with a fairly thin mineral oil in order to spread them more easily in the cold. This mineral oil supplies a little green strength, but on heating it substantially disappears. Colophony is soluble in linseed oil, and this solution forms a convenient way of introducing the resin. At the same time the total quantity of linseed oil usually used can thus be reduced. A thick resin oil, which is an industrial by-product, is also available, but its resin content and other properties are very variable. Colophony and the coal derivatives mentioned are practically insoluble in water, and increase the resistance of the core to absorption of water vapour after baking.

Class 2

These substances on heating undergo a chemico-physical change, with evaporation of water, and leave a solid residue. The commonest example is molasses, which is the uncrystallisable residue in sugar refining.

Moulding Sands and Materials

It has an appreciable green strength, and on heating leaves a solid toffee-like residue which has a fair dry strength. Glucose solutions have similar properties and sometimes occur as industrial by-products.

Another somewhat similar material is sulphite lye, a water solution of the residue produced in some processes of the manufacture of wood pulp. This gives green strength, and on heating leaves a residue with a good dry strength. Before the war it was nearly all imported. Some is produced in Britain, but, with restrictions in the manufacture of paper, the domestic output of sulphite lye has fallen correspondingly. Sulphite lye is also available as a solid which contains little water and so is more concentrated than the usual liquid form.

Class 3

These are substances dissolved in a volatile solvent which evaporates on heating. For example, rubber latex may be dissolved in a solution of ammonia in water, and, on heating, the ammonia and water are driven off, leaving the rubber. The rubber may also be dissolved in a volatile organic solvent such as trichlorethylene, which again is driven off on heating. These rubber solutions, and subsequently the cores that they yield, give off unpleasant fumes on heating and are thus objectionable in the core shop. Cellulose derivatives such as acetates and hydrates may be dissolved in organic solvents which evaporate on heating. All these cellulose solutions can be produced in Britain, but are comparatively costly to manufacture.

Class 4

These are oils which absorb oxygen on heating, leaving a solid residue of considerable strength and some elasticity. They are classed as drying, semi-drying or non-drying oils, according to the extent to which they absorb oxygen on heating. The value of this class of oil as a core binder may be roughly measured by the iodine value (I.V.). Linseed oil (I.V. about 190) is the most important drying oil and is used in a great variety of industries. Its green strength is low, but it gives very high dry strength. The drying of linseed oil on heating can be accelerated if it is previously boiled with driers such as manganese dioxide, but the dry strength of the subsequent core is somewhat reduced. During the preparation of linseed oil, by-products such as seconds, foots and linseed grease arise, which give progressively less dry strength and are also more variable in their properties. An alternative oil with a high dry strength is perilla (I.V. about 200). This is all imported and is not plentiful. Tung oil (I.V. about 170) dries very rapidly and produces a very high dry strength. It is, however, imported and comparatively expensive. Soya oil (I.V. about 130) is mostly imported, but during recent years the soya bean has been cultivated in Britain as a source of food. The oil is often hydrogenated and used as a foodstuff.

Corn oil (I.V. about 120) is a semi-drying oil produced from maize, and is largely used for food purposes. Cotton-seed oil (I.V. about 110) is a similar imported semi-drying oil, nowadays largely used in the manufacture of foodstuffs, such as butter and lard substitutes. Some fish oils are in the drying or semi-drying class. Menhaden oil (I.V. about 150), from a fish resembling a large herring, is imported into Britain from the United States of America and used largely in the paint and varnish trades. Sardine oil (I.V. about 180), obtained from the waste material in the preparation of tinned sardines, is often hydrogenated and used in the manufacture of soaps. Whale oil (I.V. about 140), formerly used extensively for quenching steels, is now largely hydrogenated for the manufacture of foodstuffs and soaps. Cod and seal oil (I.V. about 150) are also largely used as sources of foodstuffs.

Class 5

These are colloids which swell with water and leave a hard residue on heating. Ordinary glue, for example, is obtained by heating animal matter such as skins and bones with water and steam under pressure. Glues are made in Britain and are used for a variety of purposes. A solution in water gives some green strength, and on evaporation leaves a residue with a fair dry strength. Fish glues, made from the heads, skin and bones of fish, have an unpleasant odour, are more hygroscopic than animal glues and develop less bond.

Casein, manufactured from whey remaining after milk has been used for making butter, is used to prepare casein glues. Casein dissolves in water containing a base such as borax, giving glue solutions stronger and more resistant to water than ordinary glues. Casein can also be obtained from the soya bean. Albumin is a protein which is prepared from blood at abattoirs. It dissolves in water, especially if a base is present, giving a solution with little green strength. On heating, the albumin coagulates, giving a rather low dry strength.

Gum resins and gums are substances with somewhat similar properties and include ammoniacum, gamboge, myrrh, arabic, senegal and tragacanth. They emulsify with water, giving some green strength, and on heating leave a dry, often brittle, residue with a moderate strength.

Class 6

This important group covers starches and their derivatives. Starch occurs in the seeds of cereals such as maize, rice and corn, leguminous seeds such as peas, beans and runners, and tubers such as potatoes, cassava (tapioca) and arrowroot. Flour is the finely ground meal of wheat or other grain, or of some tuber such as potato. Wheat flour, in addition to starch, contains gluten, which has appreciable adhesive properties in both the green and dried states.

On boiling with water, starches or wheat flour give starch or flour pastes with some green and dry strength. On heating or roasting, starches give gums, known as starch gums, which have better adhesive properties than the pastes. On heating with a small

amount of mineral acid or alkali, starches hydrolyse to give dextrins, which are white or yellow powders, giving in core mixtures high green strength and considerable dry strength. Dextrins are the best of the commonly used materials for providing green strength, though their dry strength is much inferior to that of linseed oil.

Class 7

This covers binders of the sodium silicate type. Sodium silicates are made by fusing a mixture of silica sand and soda ash. The green strength of a water solution of sodium silicate is low, but the dry strength is moderately high, the change being due to the loss of water on heating. Binders utilising sodium silicate as a base have been successfully used in some foundries, both in Britain and on the Continent, but the refractoriness of the residue is only moderately high. The properties of sodium silicates as binders vary considerably with the ratio of silica to soda in their composition.

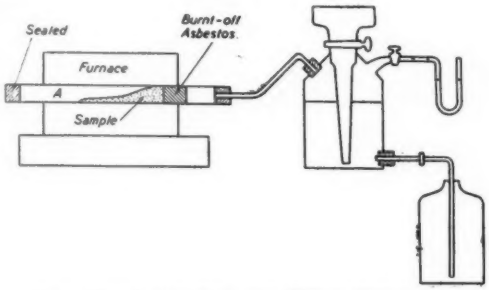

FIG. 10.—APPARATUS FOR DETERMINING THE AMOUNT OF GAS EVOLVED FROM CORE SANDS.

Class 8

As mentioned above, cores can be made in sand mixtures containing clay as the binding material, without any organic binder at all. Such mixtures retain a considerable proportion of their strength during casting and also subsequently on cooling. Whether this is an advantage or a disadvantage depends on the circumstances in each particular case. Sometimes core-sand mixtures are used in which both clays and organic binders are present, and examples of this nature are described below.

Properties and Use of Core Compounds

Core compounds are prepared by their manufacturers principally as core oils, core creams and semi-solid compounds containing dextrin and linseed oil as the most important constituents, with selected proportions of molasses, sulphite lye, resin or other binders, and some water. The properties of a core compound are the aggregate of those of its constituents, except for any modification that one constituent may produce in another. Dextrin gives high green strength and a fairly high dry strength, whilst linseed oil gives very little green strength but very high dry strength, so that, by altering the proportions of these, core compounds may be made with different properties as desired. Resin is waterproof and increases the water-resistant property of mixtures to which it is added. The optimum drying temperature varies for each material, so that the drying temperature chosen must be a compromise which will give the best all-round result.

The green and dry strengths are not the only properties of core compounds which are important. It is very desirable that the sand on the core bench should not dry off rapidly. Other factors are ease of working, flowability, resistance to water or water vapour, the nature of the core surface, the nature of

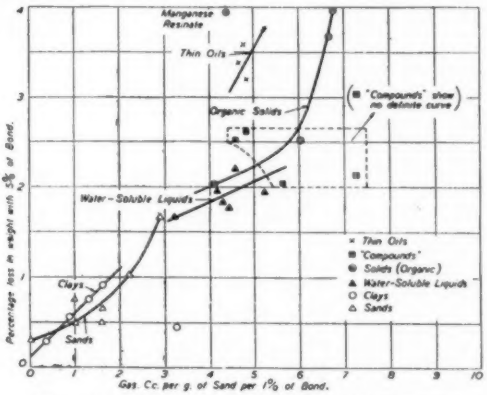

FIG. 11.—RELATIONSHIP BETWEEN GAS EVOLUTION AND LOSS IN WEIGHT FOR VARIOUS TYPES OF CORE BOND.

the residue left after burning off and the amount and nature of the gases evolved during drying and during casting.

The amount of gas evolved on heating a core is of practical importance in the foundry, since if it is excessive it may lead to blows in the casting. The volume of gas evolved when a given core-binding material is heated can be determined by using the apparatus illustrated in Fig. 10. The core-binding material to be tested is mixed in definite proportions with silica sand and baked at 205 deg. C. A 50-grm. sample of the mixture after baking is placed in the electrically-heated silica tube A against a plug of burnt-off asbestos. The tube is heated to 1,000 deg. C., and the gas evolved is collected over brine, the evolution of gas being complete when the pressure inside the apparatus becomes steady. A blank determination is carried out on the silica sand used, which is heated alone.

The amount of gas evolved can also be determined

(*Continued on page* 310.)

THE PATENTS LAW IN WARTIME

By F. J. TEBBUTT.

With the wartime Acts and many regulations concerning patents, it has been thought that a short explanation of the law as it is may be useful. Although ordinary trading with an enemy, under the Trading with the Enemy Act, is illegal, this does not altogether apply as regards patents. The position is that where an enemy-owned patent was under licence to a firm here at the outbreak of war, that patent can continue to be worked, although the Comptroller of Patents has power to revoke or vary any such licence. Moreover, the Comptroller can issue licences in respect of any enemy patent, but royalties do not go to the enemy owner of the patent, being handed over to the relevant Custodian (*i.e.*, Government officials), such sums remaining until the end of the war. After the 1914-18 war sums owing by enemy firms were set against sums considered due to enemy firms. Application from enemies for patents here are legal, but these are really received so that licences for working the patent can be granted to non-enemy firms, under the procedure just explained.

Certain matters under the law of patents must be done within certain periods (*e.g.*, renewal fees paid at various intervals), but the Comptroller is given power during wartime to extend such time limits if he is satisfied that the reason why the required matters are not done is through war circumstances.

The life of a patent is ordinarily sixteen years, but an extension can be obtained by court application in two ways, one being by "petition" and the other by "originating summons" (*i.e.*, roughly a summons for a decision on a non-contentious subject). The point precedent to the grant of an extension under the "petition" procedure (with other matters) is the court's opinion that the patentee has not been adequately rewarded by his invention. Under the "originating summons" procedure, the only point for the court to consider is whether it considers that the exigencies of war have prevented the patentee properly working his patent (*e.g.*, loss of opportunity of dealing in or developing the patent, etc.).

Extensions in normal times could only be for five years (if the case be exceptional ten years), and not more than one extension could be given. Now, under the "originating summons" provisions (*e.g.*, war losses) more than one extension can be given, irrespective of any previous extension and whether given under the "war losses" provision or the other provision mentioned, and furthermore the five years (or ten exceptionally) limitation provision does not apply, extensions being allowable, by one or more orders, provided that the extensions in the aggregate does not exceed ten years.

Ordinarily applications for extensions must be made at least six months before the expiration date of the patent, or with the leave of the court before the actual expiration date. Now, under the "war losses" provision, extensions can be considered, even after the expiration date, if the reason for delay in applying is through the patentee being on active service or through other circumstances connected with the war.

Where there has been an exchange of information or articles, between this country and an ally (*e.g.*, U.S.A.), the inventor is not to be prejudiced as regards an application for a patent, through giving such information. Under Defence Regulations, the Comptroller is empowered to delay matters and restrict publication of information in connection with an application for a patent if considered expedient in the national interest, authority must be given by the Comptroller before an application for a patent can be made in a foreign country, and any person may be required to furnish (to certain Government departments) information concerning an invention, but an application for a patent will not be prejudiced by the giving of any such information.

To overcome her transport difficulties caused by the want of repairs to the railways and the shortage of shipping space for overseas trade, the Argentine Government proposes to acquire its own merchant fleet and to adopt a policy which will give it partial independence in the matter of transport. Vessels at present under the Argentine flag total 195,000 gross registered tons, and it is planned to increase this tonnage to at least one million and to build 150 ships. A State shipyard is planned for Rio Santiago. A fleet of river vessels for internal transport is also to be built. The Government have been operating a small fleet for just over a year, during which a gross profit of 40 million pes. was made.

MOULDING SANDS AND MATERIALS

(*Continued from page* 309.)

by heating to 1,000 deg. C. for 1 hr. a standard weight of 40 grms. of the baked mixture already referred to. This is weighed after cooling, and the percentage loss in weight calculated. The results of examination for different classes of core-binding material are shown in Fig. 11. It will be observed that the bonding materials can be classified into groups with regard to the quantity of gas evolved, as follows: (*a*) Thin oils; (*b*) "compounds" (*i.e.*, mixtures of organic substances with saponifiable oils); (*c*) organic solids; (*d*) water-soluble liquids; (*e*) clays; and (*f*) sands.

Each class of material gives a group of results which is distinct from the others and characteristic of its class. There is a relation between the loss in weight and the gas evolution for each class of material, so that either method of investigation may be adopted. That is, if a loss in weight experiment is carried out for a given material, the volume of gas evolved may be obtained from the graph with a sufficient degree of accuracy. This does not apply to the so-called core "compounds," and for such materials the loss in weight is not a reliable guide to the quantity of gas evolved on heating.

(*To be continued.*)

TRAINING THE FOUNDRY APPRENTICE*

By R. OLDERSHAW

The foundry industry must give some considerable attention to the training of the apprentice moulder, for the whole future of the foundry depends upon the training these youths receive. The mechanisation and production methods of most foundries has seriously curtailed the influx of youths of the higher standard of education, which is essential if the foundry is to keep pace with the development of the allied branches of the engineering industry.

In the past the foundry has been used as a last resort for a boy who was not suitable for the drawing office, patternshop or machine shop. This has led to a general lowering of the standard of education of the foundryman, and, whilst the craftsmanship is above reproach, his technical training has been sadly neglected. Bearing these points in mind, the trade must try and attract a better type of boy, or otherwise founding will become a lost art. The majority of foundries are dirty, badly ventilated, and most uncongenial places, and this is the main reason why intelligent boys will not take up moulding as a career.

After considering the above points there are two ways of inducing the better type of lad; first, by providing slipper and shower baths, with all the other washing facilities, and lockers, and allowing sufficient time for the boys to wash and change before the usual time of stopping for the day. The other way is by monetary gain, either paying higher wages to these boys or giving a sum of money to each boy at the end of his apprenticeship. After having attracted the right type of youth, the question arises as to the training he should receive.

To Start in the Drawing Office

If a boy begins his training in the foundry when he leaves school, that is, generally speaking, when he is 14 years of age, he learns very little, because for roughly two years he is used solely as an errand boy for the moulders. This tends to make the lad lose interest. It is with this point in view that it is suggested he should commence his training in the drawing office, spending no less than twelve months in this department, so that he will be able to understand and read a drawing. This is one of the main shortcomings of a moulder—the majority cannot read a drawing. The boy's training in this department should be with this end in view, so that he could convey his opinions to either draughtsman or patternmaker with the aid of sketches, and to read a drawing and interpret what the draughtsman or patternmaker requires.

The next twelve months could usefully be spent in the pattern shop, so that he may acquire sufficient knowledge of how patterns are constructed, the amount of taper and contractions allowed, and, above all, the sole object of his period in the patternshop is so that he may acquire the art of working accurately. This is a quality always found in a good patternmaker, but is not so with the majority of moulders. Most moulders, when measuring either mould, core, or section thickness, place a rule against the part to be measured and then the thumb is placed on the rule at the other end of the measured part. This way of measuring is the general way adopted by most moulders, and it creates most of the trouble in the machine shop due to misplaced cores, facings, bosses, etc. All apprentice moulders must be taught to work and measure correctly.

Laboratory Training Included

The boy's next period of training should be spent in the laboratory, and should be of twelve months' duration. This department is looked on with suspicion by the majority of moulders; the chemist or metallurgist is someone the moulder deems unnecessary. Possibly this feeling arises through the chemist or metallurgist speaking a language the moulder does not understand because of his lack of training in this particular branch of the industry; he cannot converse with the chemist or metallurgist on matters relating to the sand, metal, etc. Therefore the boy's training in this department should be such that he understands the elementary principles of the different elements and compounds, melting practice, sand control, etc. The analytical side is not so important to an apprentice moulder. He should have a good grounding in the mechanical testing laboratory, both for sands and the physical testing of metals.

This period in the laboratory is very important because the moulder of the near future will have to work in close co-operation with the chemist or metallurgist, for the trend is for higher duty alloys, which means greater control of the moulding technique.

The boy has now reached that stage when he is to begin his training in the foundry. This training will be of four years' duration, and should be as varied as possible. He should be moved all round the shop and have a limited period on every type of work, *i.e.*, core making, small work moulding, core-iron making, open sand work, loam moulding, large floor moulding, and green and dry sand.

Coupled with this practical training he should be encouraged to attend evening classes, and if possible he should be allowed to attend day classes where suitable courses exist. No pressure should be brought upon the boy to attend evening classes before the age of 16, but, if he chose of his own free will, it is advantageous for him to take English and arithmetic. These are two subjects in which the majority of boys seem to be lacking. After the age of 16 the boys should follow a set course for foundry workers, and an ideal course is the one by the City and Guilds for Foundry Practice and Science.

After having heard these suggestions some might object that it is too much to ask of a boy to attend evening classes after having worked hard all day. The author subscribes to the old adage, "All work and no play makes Jack a dull boy," and hav-

* A prize winning entry in a competition organised by the West Riding Branch of the Institute of British Foundrymen.

Training the Foundry Apprentice

ing this in mind, he deems it essential that a social and athletic club should be run for these apprentices. If a foundry has not a sufficient number of boys to warrant a club of its own, one could be organised for all foundries in the locality.

Discussion

MR. H. FORREST, opening the discussion, said, personally, he agreed entirely with the theme of Mr. Oldershaw's Paper—that there was a grave shortage of men in the foundry industry and that the men the industry needed must be of a higher educational standard than had commonly come into foundry work in the past. The class of men entering the trades within the industry has been due largely to the fact that no proper inducement had been given. Lads had been taught to be nothing much more than errand boys until perhaps they eventually got cleared out because they had grown to an age demanding more money and then the foundry has sought some fresh boys at the cheaper rate. It was obviously preferable to take a boy into the foundry with a view to his being thoroughly trained in the work, including the attendance at evening classes or other part-time educational work. This might bring out the particular aspects of foundry work to which he is most attracted and fitted, and it might be well not to put him into the various phases of the foundry's work until his personal bent had been ascertained. There was a danger of cramming too much into the short space of apprenticeship period and a waste of time in putting him on some kind of work for which he might be entirely unsuited. One cannot, of course, lay down any hard-and-fast rule, but there was a need for every possible means of encouraging apprentices who were intended to learn the job thoroughly.

MR. W. G. THORNTON said he agreed with the theme of the Paper in general, and he felt it was up to all executives in the industry to make foundry work as attractive as possible for lads of a better educational standard. Had the author had any experience corresponding to the case where a boy who had matriculated was sent to take some studies at the technical college and yet, when he became 18, he asked to be a plate moulder merely because that job yielded him twice the money immediately. He had apparently no thought for the future.

A Better Standard Sought

The AUTHOR agreed that if a boy was found to be leaning definitely to any particular branch of the industry, it was desirable to turn him into that direction. His object was not the acquisition of a lot of brilliant boys, but to get a generally better level than had been the case in the past. In answer to MR. TURNER, who queried what sort of special intellect the author was expecting to get for moulding work, MR. OLDERSHAW said it was to be assumed that a moulder would be the better for some knowledge of metallurgy. Not all foundries could afford to maintain the metallurgical chemist. If a young man was entering for a career, he should be sufficiently educated to be able to develop into a craftsman.

MR. TURNER said his view was that a young man, if he was going to be a skilled moulder, would not have much spare time to study metallurgy; he would have his work cut out to become a first-class craftsman moulder.

The PRESIDENT (Mr. F. Oldershaw) said, if boys were going to be satisfied with being nothing more than good practical moulders, then the industry was going to have a difficulty in getting administrative executives in the future. Furthermore, if a trade slump came and a man lost his job, he might not find it easy to get another if he were more or less a one-job specialist and helpless to take on some alternative kind of work.

A MEMBER said he felt the average boy coming into the foundry at, say, 14 years of age, was generally too young to benefit from going straight into the laboratory or the drawing office; he would be better employed on practical work until he was better able to understand these phases of the work.

The AUTHOR said his experience was that the younger the boy the more receptive he was to learning in general.

MR. D. JEPSON, M.Sc., said in the first place they had to find the right type of lad for the job. Some day there would be a better system of vocational guidance for boys, which would take into account temperament, etc., quite apart from technical abilities. For a moulder the first thing would be to set out what was the type of ability and temperament to be sought, and having decided that, then one could decide the manner of attraction. He hardly thought the suggested baths and similar social amenities would carry a great deal of weight in this regard. So far as concerned training, either an entirely practical or an entirely technical man was an unbalanced man, and for the apprentice half the time should be spent in each direction. Which of the two ways came first or last was a matter of detail. Personally, he failed to see why they should not come together. Evening classes were rather a strain on a lad after a hard day's work, and he favoured a half-time work and study system during the daytime.

MR. J. BLAKISTON said he considered Mr. Oldershaw's Paper was one which should be taken very seriously by all in the industry. The foundry industry was making for a "show-down" in the matter of supply of apprentices. The industry was becoming peopled by elderly men, and that could not go on for ever. The whole issue had to be faced in the very near future, and it should not be put off any longer. The industry had come to a poor state of affairs when the foundry had to bring in the engineer or the metallurgist when it required an executive, because it could not find anybody suitable from its own ranks. This Paper should be published in the FOUNDRY TRADE JOURNAL for study by everybody in the industry, and he felt there should be a rider added in the form of a question—"When is this matter going to be tackled?"

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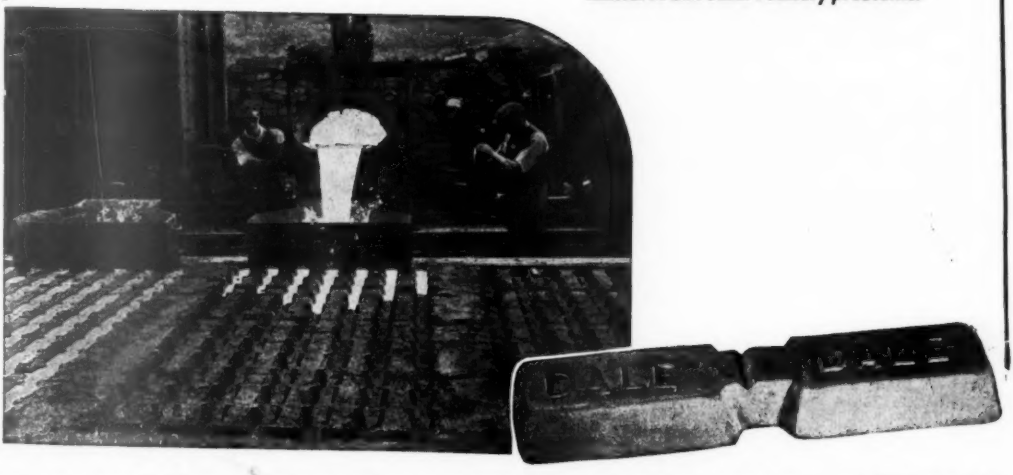

THE STANTON IRONWORKS COMPANY LIMITED, NEAR NOTTINGHAM

RESEARCH IN THE STEEL INDUSTRY

The importance of research work in the steel industry, particularly in relation to post-war possibilities, was stressed by Mr. John E. James, the chairman and managing director, at the annual meeting of the Lancashire Steel Corporation, Limited.

Mr. James said that the war had revealed to the industry more than ever before the value of research and its effect upon the technical side of the industry, and greater provision for research would naturally require to be made in post-war years than had been devoted to this purpose in the past. The investigations which would be necessary could, he considered, be done most effectively both by individual companies and by the industry acting collectively. Individual companies, for example, might develop those types of research in their laboratories which could be pursued and tested in their own works, transferring thereafter to collective research the results of these investigations. The Lancashire Steel Corporation had itself many avenues both in raw materials and in finished products which provided great scope for such work, and in exploring these he was hopeful that they might be able to make some contribution towards at least one object of research—namely, the standardisation of methods of manufacture. The whole question was one of great interest, and Mr. James felt convinced that very considerable attention would require to be paid to it in future.

OBITUARY

MR. AMOS ENGLAND, who died recently, was chief chemist of Blythe Colour Works, Limited, enamel manufacturers, Cresswell, Stoke-on-Trent.

MR. CHARLES EDWARD PARKER, a former director of Thos. W. Ward, Limited, engineers, etc., Sheffield, died recently, aged 70. He retired about 12 years ago.

MR. JOSEPH LUPTON WILSON, sales manager and a director of the British Thomson-Houston Company, Limited, died last week. He was 60 years of age. Mr. Wilson was also a director of Ferguson Pailin, Limited, and other companies.

DR. HENRY FORSTER MORLEY, late Director of the International Catalogue of Scientific Literature, and of the Royal Society's Catalogue of Scientific Papers, died recently. He was 88 years of age.

MR. ALEXANDER STENHOUSE LEGAT, chairman of the Coatbridge Gas Company since 1915, died recently. Mr. Legat was manager of the former Carnbrae Ironworks of Merry & Cuninghame, and joined the board of directors of the Coatbridge Gas Company in 1905.

MR. WILLIAM HAMILTON BOWLEY, who was connected with Ambrose Shardlow & Company, Limited, manufacturers of micrometers, drop forgings, etc., of Sheffield, for 34 years, has died, aged 53. He was formerly chief accountant and was appointed secretary of the company in 1938 and made a director in 1941.

IN PARLIAMENT

Barrow Haematite Steel Company

SIR L. LYLE asked the Minister of Supply whether he could make a detailed statement of the reasons which had actuated him in buying the Barrow Haematite Steel Company.

SIR ANDREW DUNCAN: The purchase is not of the shares of the Barrow Haematite Steel Company, but only of part of their works. A contract has been made for the purchase of the steel works and hoop works of the company in order to carry out improvements which the company themselves were not in a position to undertake. The modifications will be directed in the main to improving the quantity and quality of the steel ingot production.

Appointment of "Government Directors"

Replying to criticisms of the Government's power to appoint directors of industrial companies, MR. OLIVER LYTTELTON, Minister of Production, told the House last week that it was not intended to reverse the policy of employing private enterprise to produce munitions. He said it was a reasonable measure which would promote efficiency and prevent the exercise of very drastic powers. The Minister gave pledges that in all cases before taking action under the regulation the Ministers would refer to the Inter-departmental Committee in his Ministry known as the Craven Committee, which would give an opportunity to companies to make representations; and that before defining the field over which the regulation applied the Treasury would be brought into consultation as to what was a "substantial" investment within the meaning of the clause.

After those assurances had been given, MR. SIMMONDS withdrew a prayer which he had moved for annulment of the order authorising the new regulation. The question of the appointment of Government directors was also raised in the House of Lords when LORD PORTAL gave similar assurances to those given by Mr. Lyttelton.

REFUSED ENTRY BUT PAID WAGES

When Switchgear & Cowans, Limited, of Old Trafford, were fined five guineas at Manchester last week for failing to reinstate a dismissed workman, the firm was said to be willing to pay him £500 a year to keep away "because of the trouble he had caused." Mr. C. O. Hockin, prosecuting for the Ministry of Labour, said that the company dismissed a man named Goodwin for alleged serious misconduct. Goodwin's reinstatement was recommended by the local appeal board, which held that the firm's allegation had not been made out. The firm failed to comply with the direction and, although refusing Goodwin entry to the works, continued to pay his wages. It was urged that by so doing the firm had legally reinstated Goodwin.

The firm was fined and ordered to pay three guineas costs.

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NEWS IN BRIEF

ABAIR ENGINEERING, LIMITED, is being wound up voluntarily. Mr. G. L. C. Touche, Basildon House, Moorgate, London, is the liquidator.

HENRY ROBB, LIMITED, shipbuilders, of Leith, have just celebrated their silver jubilee. The firm was founded by Mr. Henry Robb on April 1, 1918.

PEARSON & KNOWLES COAL & IRON COMPANY, LIMITED, announce that their offices are re-established at 3, Finch Lane (Threadneedle Street), London, E.C.3.

COMMUNICATIONS for the Home Ore Section of the Iron and Steel Control, Ministry of Supply, should now be sent to Ashorne Hill, near Leamington Spa, Warwickshire.

AFTER A LAPSE of two years, Irish Steel, Limited, have restarted operations at their Haulbowline steel mills. Reconstruction work is being continued. Some 120 men are employed.

MR. STEWART COLE, 18, Essex Street, Strand, London, W.C.2, has been appointed liquidator (with a committee of inspection) of Poplar Engineering, Limited, Park Road, Chesham.

FIFTY INDUSTRIAL SALVAGE groups, comprising nearly 1,000 firms, have been established during the past two months and ninety further groups are now being formed, while a much larger number has been planned.

AT A MEETING of the Barrow Haematite Steel Company, Limited, recently, the shareholders approved the sale to the Ministry of Supply of the company's steelworks and hoop and bar mills for £640,000. The company, as announced in our last issue, will retain its ironworks, iron-ore mines, and limestone quarries.

THE PARTNERSHIP carried on by William Fellows Marvin, Herbert Edward Wright, Norman Leigh Hayes and William John Farthing, under the style of Hayes & Marvin, at The Quay, Gloucester, brass and iron founders, has been dissolved by mutual consent. In future the business will be carried on by William Fellows Marvin, Herbert Edward Wright and Norman Leigh Hayes in partnership.

SIR CHARLES DARWIN, scientific adviser to the Army Council, has returned to his duties as Director of the National Physical Laboratory at the request of the Lord President of the Council. He has been succeeded as scientific adviser by Prof. C. D. Ellis, who had been serving as deputy scientific adviser. Sir Charles' services in a consultative capacity will continue to be available to the Army Council.

THE COMPANIES REGISTRATION OFFICE gives notice that the names of the undermentioned companies have been struck off the register, and such companies are dissolved:—Godfrey Engineering Company, Limited; International Consolidated Steel Trust, Limited; Omega Engineering Company, Limited; Stainless Steel Goods, Limited; Universal Rustless Steel Corporation, Limited.

THE ANNUAL Manchester Association of Engineers' lecture will be held at the Great Hall, College of Technology, Sackville Street, Manchester, on May 28 next, at 7 p.m. The lecture will be delivered by Sir Frederick Handley Page, and his subject will be "Commercial Air Transport." Admission will be by ticket, which may be obtained from the Assistant Secretary, St. John Street, Chambers, Deansgate, Manchester, 3.

THE "NICKEL BULLETIN" for March gives a summary of the services schedule of non-ferrous metals and alloys for armament and general engineering purposes, and also deals with the production of bronze castings, amendments to En. and N.E. steel specifications and the determination of lead, molybdenum and aluminium in steel. Copies of the "Bulletin" may be obtained, free of charge, from the Mond Nickel Company, Limited, Grosvenor House, Park Lane, London, W.1.

PERSONAL

MR. G. PARSLOE has been appointed secretary of the Institute of Welding.

MR. JOHN CHARLES GAMMON has been appointed an additional director of the Cementation Company, Limited.

MR. J. H. JOLLY has been elected a deputy-chairman of Guest Keen & Nettlefolds, Limited. He is a managing director of the company. Mr. Jolly is deputy-chairman of Guest Keen Baldwins Iron & Steel Company, Limited.

MR. J. B. HUTCHISON, a director of Scott's Shipbuilding & Engineering Company, Limited, Greenock, has retired, and Mr. J. A. Pearson has been appointed general manager of the shipbuilding department to succeed him. Mr. Hutchison joined the company 42 years ago from a managerial position in the old London & Glasgow Shipbuilding Company, Govan, and he has been a director since 1910. In 1932 he was president of the Shipbuilders' Federation, and he was previously president of the Clyde Shipbuilders' Association.

MR. E. BARNARD has been appointed Principal Assistant Secretary, and Mr. R. O'F. Oakley and Mr. G. R. D. Hogg to be Assistant Secretaries, in the Department of Scientific and Industrial Research. Mr. Barnard joined the administrative staff of the Department in 1919, and Mr. Hogg in 1920. Mr. Oakley joined the administrative staff in 1920. He became assistant to the Director of Fuel Research in 1938, but since 1940 his services had been lent to the Ministry of Home Security as Deputy Chief Adviser, Research and Experiments Department.

Wills

KIRKPATRICK, G. L., Edinburgh, managing director of Bruce Peebles & Company, Limited, engineers £9,294

BEARDSHAW, D. E., of Sheffield, formerly a director of J. Beardshaw & Son, Limited, steel and tool makers £16,068

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COMPANY NEWS

(Figures for previous year in brackets.)

Heatrae—Dividend of 12½% (same).

Colvilles—Final ordinary dividend of 5%, making 8% (same).

William Beardmore—Final ordinary dividend of 7%, making 10% (same).

William Blythe & Company—Final dividend of 10%, making 15% (same).

Veritys—Interim dividend of 7½% for 1942 (same; no further dividend paid for 1941).

Josiah Parkes & Sons—Net profit for 1942, £15,010 (£14,809); dividend of 10%, £7,500 (same).

United Flexible Metallic Tubing—Final dividend of 6% (5%), plus a bonus of 3% (6½%), making 15% (same).

Range Boilers—Net profit, £11,391 (£11,881); final dividend of 10% and a bonus of 5%, making 20% (same).

Brunton's (Musselburgh)—Profit for 1942, £37,754 (£36,822); ordinary dividend of 20% (same); forward, £22,020 (£16,766).

Telegraph Construction & Maintenance—Net profit for 1942, £49,365 (£50,825); final dividend of 5%, making 10% (same).

Birmingham Railway Carriage & Wagon—Net profit for 1942, after providing for taxation, £74,754 (£49,969); ordinary dividend of 7½% (same); forward, £99,694 (£130,284).

Wigan Coal & Iron—Profit for 1942, £17,117 (£47,278); dividend of 4% on reduced capital of £904,862 (5% on previous capital of £1,809,725); forward, £18,097 (£14,490).

South Durham Steel & Iron Company—Final dividend of 2½% (2%) on the ordinary shares, making 8½% (8%), and a dividend for the year on the "B" ordinary shares of 2½% (2%).

Newey & Tayler—Dividends from subsidiaries and sundry receipts, less expenses, £19,079 (£17,597); preference dividends, £4,500 (same); interim dividend of 2½% on the ordinary shares, £3,250 (same); final dividend of 7½%, £9,750 (same); forward, £3,305 (£1,727).

Ideal Boilers & Radiators—Net profit for 1942, £298,838 (£112,501); to reserve for taxation and contingencies, £140,000; dividend (gross) on the preference shares, £50,000; final ordinary tax-free dividend of 1s. per share, making 15% (7½%), tax free; forward, £212,822 (£208,984).

John Summers & Sons—Trading profit for 1942, after deducting depreciation, £1,066,253 (£874,494); provision for taxation and war damage insurance, £541,589 (£480,588); dividends of 8½% (6%) on the "A" stock and 4½% (2%) on the "B" stock, compared with 6% and 2% for 1941.

Enfield Cable Works—Profit for 1942, £203,396; depreciation, £28,702; A.R.P., £7,471; net profit, £166,623 (£217,039); to reserve for taxation, £50,000; dividend on the cumulative preference shares, £15,000; final dividend of 6½% on the ordinary stock, making 12½% (same); forward, £13,170 (£11,547).

Lanarkshire Steel Company—Profit for 1942, after making provision for war damage insurance and taxation, £50,773 (£46,149); depreciation, £40,000 (same); to reserve, £5,000 (same); preference dividend, £8,250 (same); dividend on the ordinary shares of 12½%, £11,562 (same); forward, £53,537 (£68,176).

Sir Wm. Arrol—Trading profit for 1942, £211,470 (£190,627); depreciation, £18,000 (£16,000); A.R.P., war insurance, etc., £5,618 (£15,036); taxation, £128,500 (£105,000); net profit, £59,352 (£54,591); preference dividend, £15,050 (£13,921); total ordinary distribution of 25% (same), £14,835; general reserve, £25,000 (same); forward, £51,102 (£46,635).

Associated Electrical Industries—Profit for the year ended December 31 last, after providing for taxation, £686,527 (£681,536); depreciation, £233,707 (£263,296); to contingency reserve, £150,000 (£100,000); dividends paid on £1,307,642 8% cumulative preference stock, £52,306 (same); dividend on the £4,921,838 ordinary stock of 10% for the year, £246,092 (same); forward, £289,736 (£285,314).

Universal Asbestos Manufacturing—Trading profit to September 27 last, £125,566 (£160,684); depreciation, £9,435 (£10,996); off patents, £227 (£204); fees, £1,600 (same); income-tax, £32,000 (£29,800); E.P.T., £61,500 (£99,200); net profit, £20,804 (£18,884); to preference capital redemption reserve, £1,793 (£1,568); preference dividend, less tax, £2,878 (£3,201); ordinary dividend of 20%, £10,000 (same); forward, £53,024 (£47,890).

John Baker & Bessemer—Profit for 1942, after providing for all charges, including depreciation, income-tax and E.P.T., £25,500 (same); written off war damage insurance, £2,380; dividend on the preference shares, £7,820; dividend of 10% on the ordinary shares, £12,398; forward, £23,414 (£20,512). Pointing out that the surplus is the same as last year, the directors state that it is necessarily so, because no matter what the gross profits may be, the retainable surplus is fixed by the standard profit.

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

L.S. Scrap Metals, 2a, Stoke Newington High Street, London, N.16—£1,000. W. Markus.

Soho Tinning Company, Argyll Works, Alma Street, Smethwick—£2,000. R. C. and D. Molineaux.

Lintern Trading Company, 2, Celyn Grove, Cyncoed, Cardiff—Engineers' agents, engineers, etc. £1,000.

Chandem Engineering Company, 8, South Drive, Cheam, Surrey—£1,000. F. G. and M. R. Hedgeland.

Super Welding (Clayton), 3, St. James's Square, Manchester, 2—£2,000. R. S., E., and E. A. Hughes.

Synthalloy, 41, Westgate Street, Cardiff—Manufacturers of and dealers in synthetic materials, metals and alloys, etc. £5,000.

T. Bashforth & Company, Don Foundry, Town End, Doncaster—Founders and engineers. £1,000. B. and S. Wilson, and G. Hoyle.

W. T. L. Lintern & Company, 2, Celyn Grove, Cyncoed, Cardiff—Engineers' agents and representatives, engineers, etc. £2,000.

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Raw Material Markets

IRON AND STEEL

There have been no major developments in the light-foundry trade since it was announced that the scheme for the concentration of the industry had been halted. Some of the foundries report an accession of business, but this concerns only those works which have been able to switch over to the manufacture of engineering castings, and many of the light foundries have not been able to do this as yet. It seems likely, however, that the authorities intend to make additional use of the light-foundry trade, and it is expected that this section will gradually play a more important part in the production of war materials.

Heavy engineering and allied foundries are experiencing very brisk conditions, their order-books being filled with orders for various Government departments. Special types of pig-iron which are utilised extensively in these foundries are, of course, in full demand. Owing to the shortage of these descriptions, however, high-phosphorus and refined irons, steel scrap, etc., are being used where possible. The Control are exercising the utmost care in the distribution of the better qualities, but other grades produced from home ores are available in large tonnages and many buyers have accumulated appreciable stocks.

Finished-steel makers are briskly employed on a wide range of products required for the production of war materials. The steel requirements of the shipbuilding industry continue to absorb vast tonnages, particularly of plates, the demand for which is incessant not only for ship construction, but also for the manufacture of tanks, boilers, wagons, etc. Power-plant makers have lately increased their plate specifications, which are at a high level. Shipbuilders are also making considerable demands on the resources of the sheet makers, who are very busy. Aircraft and tank works are using all the alloy steels they can purchase and these descriptions are urgently required for important purposes.

Steelworks are ready to accept delivery of all suitable grades of scrap and consumption is at a high level. The heavier and better qualities are moving away well, but it is still difficult to dispose of some other grades. The foundries are absorbing large supplies of heavy cast-iron scrap, but there is little interest in clean light iron at the present time. Heavy iron scrap for the foundries is inclined to be somewhat scarce in certain districts, but, on the whole, the requirements of these consumers are being met satisfactorily.

NON-FERROUS METALS

Bolivia's declaration of war against the Axis Powers draws renewed attention to the importance of her tin deposits to the United Nations. Production of tin in those countries whose output is still available to the Allies is mounting under the stimulus of war demands, and the Bolivian production is no exception. The future can be regarded with confidence despite the fact that such a large proportion of the world's tin deposits is in the hands of the Japanese. In the early days of the war prudence directed the accumulation of stocks of tin in the United Kingdom and in America, and the wisdom of this procedure was evident when Japan gained control of the mines in the Far East previously held by British and Dutch interests. It is probable that these reserves are still substantially intact, and it can be confidently assumed that really essential needs will continue to be met. There can be no possibility, however, of other than small supplies being made available for purposes outside the war effort, and economy in use and the utilisation of substitutes must remain features of the tin situation so long as hostilities continue.

Consumption of copper on both sides of the Atlantic is on a very large scale, and demands that the utmost care be exercised in distributing available supplies, despite the large tonnages at the disposal of the Allies. It is important, too, that the maximum use be made of scrap and secondary metal. Great Britain continues to rely mainly on Canada and Rhodesia for her supplies of copper, and the use of shipping space is inevitably involved. The same consideration applies to spelter and lead and, indeed, most other non-ferrous metals. Imports, even of essential materials, must be kept down to the minimum, in order that the best strategic use may be made of Allied shipping.

THE AMERICAN AUTOMOTIVE COUNCIL for War Production reports that the industry now has 986 plants in 31 States.

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